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Designing Tailored Displays for Clinical Practice Feedback: Developing Requirements with User Stories

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Abstract

Improving visualizations in clinical quality reports and dashboards may improve the visualization influence on clinical practice. Tailored displays could accommodate individual and situational differences, but these diplays introduce complex requirements across healthcare professionals and teams. We applied user stories, a method for managing complex software requirements, to a user-centered design process for tailored visual displays about postpartum contraception care. We mapped user stories to tailored displays to identify the quantity of displays that were supported by each user story. We developed 9 tailored displays and 11 user stories. Displays varied in their mappings to user stories (mean 5, max 9, min 0), revealing differences in healthcare professionals and teams preferences and information needs. User stories and user-centered design may be useful for healthcare organizations to manage complex requirements of tailored displays in clinical practice feedback.

Keywords:

Feedback, quality improvement, software design.

Introduction

Clinical quality reports and dashboards are widely used to communicate about clinical performance to healthcare professionals and teams [1,2]. Visual displays, such as charts, graphs, and tables, are a central component of dashboards and performance reports because of the ability to reduce the cognitive burden required to understand performance data [3,4]. However, evidence about the use of these reporting tools as feedback interventions to change practice shows a wide range of results [5], suggesting that ideal conditions may exist under which performance feedback is highly influential on clinical practice.

An approach that may achieve ideal conditions is the tailoring of feedback reports where population-level practice feedback could deliver prioritized, actionable information [6]. Tailoring information has been demonstrated to improve cognitive processing of messages and the effects on motivation in the field of health promotion and communication [7]. Tailored feedback could accommodate provider differences such as numeracy and graph literacy, which can vary among healthcare professionals [8,9], and to accommodate changing priorities based on evolving gaps and trends in quality measures. Tailoring feedback requires representations of individual and situational difference characteristics that may change over time across healthcare professionals and teams.

User stories are a method for managing software requirements in complex and dynamic environments from the agile software methodology [10]. A key feature of user stories is that they associate a specific software function (what) with a specific user (who) and a rationale (why). User stories have been applied in an agile approach to clinical decision support [11] and quality dashboard development [12], but to our knowledge have not been applied to the development of feedback reports for the purpose of tailored messaging.

User-centered design is increasingly used in healthcare to develop information resources, including performance feedback reports [13]. We applied user-centered design methods to develop prototype clinical quality feedback reports for healthcare professionals and teams in a department of obstetrics and gynecology at an academic medical center. The focus of this work was to support the implementation of a new practice of offering immediate postpartum long-acting reversible contraception (IPLARC) to patients. The objective of this study was to explore how user-centered design and user stories could support complex requirements management for tailored displays of clinical performance.

Methods

Setting and Participants

This work was done in an academic department of obstetrics and gynecology that provides clinical quality feedback to approximately 40 providers in a regional health system with 8 clinics in the midwestern United States. Healthcare professionals in the department include nurses, midwives, resident physicians, and attending physicians. The department routinely measures the quality of care using EHR and administrative data. Reports are routinely produced in a clinical quality dashboard. A single report is also sent monthly via email about appropriate screening for vaccination. We recruited participants for the user-centered design activities via email. They were not financially compensated. We focused on the measurement of performance for postpartum contraceptive counselling. The study was determined to be not regulated as human subjects research by the University of Michigan Medical School IRB (HUM00140107).

Design Process

We designed tailored displays and user stories in iterative and multi-stage process (Figure 1). The process of tailoring prototype displays involved a qualitative component that served to

generate themes for both the display design process and for user story development. At the conclusion of the design process we mapped tailored displays and user stories to understand the comprehensiveness of the displays in addressing individual and situational difference characteristics described in user stories.

Tailored Prototype Display Development

Prototype design displays for feedback reports in the following steps: 1) iterative low-fidelity prototyping with contextual interviews and usability testing, 2) affinity diagramming, and 3) high-fidelity prototype development.

Iterative Low-Fidelity Prototyping

We conducted 30-minute contextual interviews with healthcare professionals from each provider role in the department (midwife, nurse, resident, attending physician). We audio-recorded interviews and took field notes to identify the existing feedback reports that participants use, the channels through which feedback reports were delivered, and the contexts in which reports were viewed. We also asked open-ended questions about the goals and preferences of healthcare professionals with respect to receiving, understanding and acting on feedback reports.

We collected examples of feedback reports in the OB/GYN department and designs from published examples in the literature to inform the creation of low-fidelity prototypes. We held 4 design meetings to generate a wide range of initial display possibilities in sketches on paper. We prioritized a group of displays from an initial set of sketches for testing and we created initial prototypes for testing with synthetic performance data.

We tested the usability of the prototypes using think-aloud technique, asking each provider to verbalize their thoughts as they viewed each prototype. We also tested the comprehensibility of prototypes by asking participants questions like "what is your clinic's performance this month?". After displays had been tested, we asked participants to compare and express their preferences for the prototypes. We recorded audio and took notes in usability testing sessions.

Affinity Diagramming

We created an affinity diagram to identify themes from interviews and usability testing [14]. We used post-it notes to write down interview quotes, facts, and observations. Similar notes were grouped together and new groups were formed when notes did not fit in an existing cluster. Each cluster of post-it notes addressed one theme or idea. We looked for similarities and differences between different professional groups in terms of preferences to identify requirements for tailoring feedback.

High-Fidelity Prototype Development

After iterating through the display designs, we eliminated displays that proved to be inappropriate, unanimously unpopular, or difficult to comprehend. We created high-fidelity prototypes using Sketch (Hague, NL) design toolkit based on our tested low-fidelity prototype displays.

User Story Development

We wrote user stories based on the themes from affinity diagramming [Table 1]. One member of the study team drafted the stories, and a second team member proposed revisions to create the set of stories for analysis. These user stories followed the three-part format of:

*As a*_____

I want to receive performance feedback _____

So that I can _____.

Mapping User Stories and Prototype Displays

To map user stories with prototype displays, two members of the study team independently selected the prototype displays that appeared to be compatible with each user story. Selections were recorded in a shared spreadsheet. One team member identified differences in selections and then both team members met to resolve differences through discussion.

Results

Prototype Design

Design activities took place over a period of 5 months between June and October in 2018.

Iterative Low-Fidelity Prototyping

We conducted 3 cycles of contextual interviews, low-fidelity prototyping, and usability testing. We interviewed 10 healthcare professionals, including 2 attending physicians, 2 nurses, 4 midwives and 2 residents.

We developed 13 low-fidelity prototype designs for testing.

We conducted 4 usability testing sessions with attending physicians to test the usability of the displays.

As we iteratively developed low-fidelity prototypes, we gained insights that lead us to focus on specific user groups and to refine elements of the low-fidelity prototypes. We learned that the performance measures focusing on IPLARC were not directly actionable for nursing staff, therefore we did not seek to test the usability of prototypes with nurse participants. We learned that resident physician's goals and preferences were focused on immediate feedback about skill

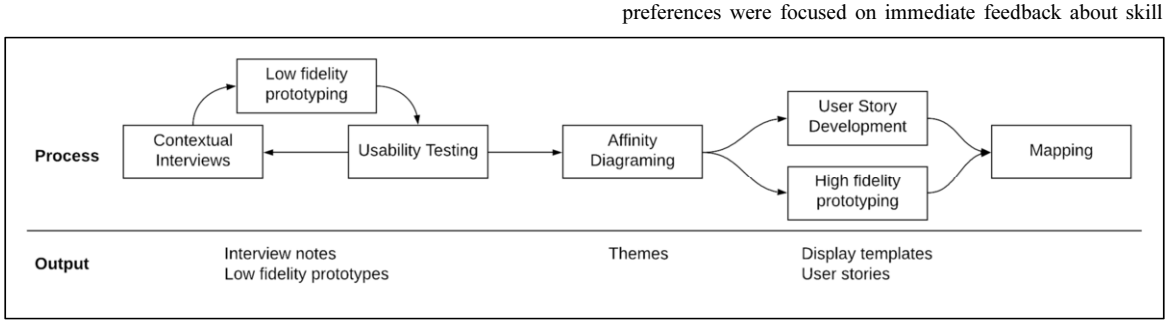

Figure 1– User-Centered Design Process for Tailored Displays of Clinical Performance

Table 1— User Story Development

Quotes	Theme	User Story
"I like seeing c-section rates and the trends" - *Midwife 2* "It's nice to see the trend" - *Midwife 4* "Trend is helpful... what is the reason behind this trend for the clinic?" - *Attending Physician 1*	Providers like seeing trends in the report	**As a** provider, **I want to** receive performance feedback reports that shows trends **So that** I can see how my clinic's performance changes over time.
"I like seeing the comparison of how you're doing in relation to other clinics" - *Attending Physician 4* "I'm competitive, it's nice to see I'm the best...I like comparison" - *Attending Physician 6*	Attending physicians want to see names and performance of other clinics	**As an** attending physician, **I want to** receive performance feedback with data from other clinics **So that** I can compare my clinic's performance to others.

acquisition to the extent that summary performance feedback about individual management of patient and especially for clinic-level performance was perceived to be largely not actionable. We also learned that midwives in the department used a separate performance measurement and feedback process that was distinct from physician-focused quality improvement reporting. Given the available resources for the project we focused our scope on attending physician feedback, who voiced the most support for the utility and actionability of the feedback reports in contextual interviews.

High-Fidelity Prototyping and User Stories Mapping

We identified 11 themes in an affinity diagram. We identified themes about display features and report delivery. We iteratively developed display designs in 3 cycles. We created 9 high fidelity prototype displays for our collection. Each display contains one graph or table with synthetic performance data. We created 11 user stories based on these themes. Each user story corresponded to a single theme from the affinity diagram [Table 2].

The mapping process helped us to identify 2 user stories that were not supported (8 and 9) and two user stories that were each addressed by only a single display (10 and 11). We also identified four user stories(1, 3, 5 and 6) that were supported by all 9 displays. Prototype displays were mapped to an average of 6 user stories (min 5, max 7). User stories were were mapped to an average of 5 prototype displays (min 0, max 9).

Table 2— User Stories

	User Story		
Story ID	**As a...**	**I want to...**	**So that...**
1	provider	receive performance feedback reports regularly	I can check them routinely
2	provider	see a target or goal value in the performance feedback reports	I can track and compare my performance
3	provider	see both percentages and raw data in the performance feedback reports	I can better understand the reports
4	provider	receive performance feedback reports that shows trends	I can see how my performance changes over time
5	attending physician	receive a performance feedback report about counselling, placement and outcomes of IPLARC	I can evaluate my performance holistically
6	attending physician	receive a performance feedback report within the body of an email	I can spend less time opening attachments
7	attending physician	receive performance data from other clinics	I can see how well my clinic is doing compared to others
8	provider	know how my performance data is collected	I can better understand the performance feedback reports
9	resident	receive feedback about my performance immediately	I can improve my skills and techniques
10	attending physician	receive a congratulations message when my clinic performance is consistently high for 4 months	I can recognize our achievements
11	attending physician	receive a "fun" feedback report	I am more likely to look at the report when I receive it

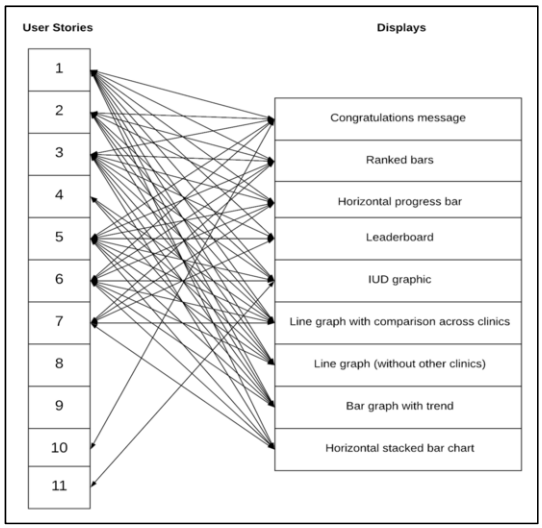

Figure 2– Mapping between User Stories and Display Prototypes. User story numbers correspond with numbers in table 2

Discussion

User stories are a promising approach for representing complex requirements to tailor clinical practice feedback displays to healthcare professionals and teams. Our preliminary experience with a user-centered design method for tailored feedback suggests that user stories may enable improved design, evaluation, and maintenance of tailored feedback interventions. We applied this process to support performance measurement and feedback about IPLARC to healthcare professionals and teams. Incorporating user stories into the design process enabled us to represent contextual factors and preferences of participants that have potential to improve the effectiveness of feedback reports about the quality of clinical practice by supporting the delivery of tailored feedback.

Mapping user stories to displays gave us insight into the ability of a collection of displays to support variable requirements that represent a critical first step toward the delivery of tailored feedback. The mappings served as a preliminary validation of the collection of displays, indicating that each display supported a minimum of 5 user stories. Mapping also revealed the stories that were not supported by any displays. For example, an absence of mappings to Story 9 confirmed what we had learned in contextual interviews about the preferences of residents for receiving performance feedback that was not compatible with the current types of performance measurement that our project supported [Table 2]. Similarly, an absence of mappings to Story 8 revealed a preference that was beyond the scope of this project to address but represented an important next step in the the report design process.

User stories require the story developer to provide a rationale for the user's desire to have a specific function in the information resource. Including a rationale can support the maintenance of tailored reports as user context evolves but also enables feedback report developers to identify stories with rationales that are no longer justified and then to identify the displays that they are supported by for revision or removal from an active collection of tailored displays.

A promising aspect of this approach is the potential to use user stories to develop metadata for tailored displays and to automate the delivery based on user roles and personal profiles. We also anticipate that user stories could be used to improve the user-centered design process if used in a participatory approach [15].

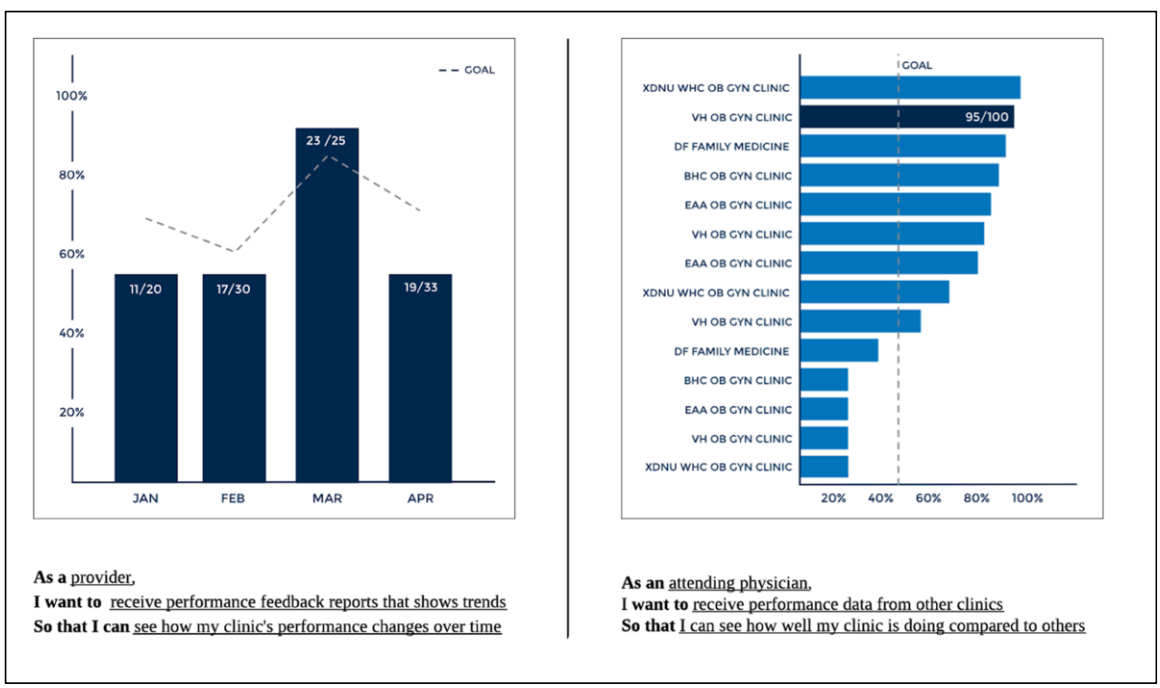

Figure 3– User Story - Display Mapping. Each display is mapped with the user story below it and is incompatible with the other user story.

A limitation we encountered with the user story structure was that it is not appropriate for expressing negative themes. Representation of negative themes is not necessary for general characteristics of reports, but may be necessary to express requirements that differ between users within a context or professional role.

A limitation for this exploratory study is the preliminary nature of the analysis. In some cases, we did not elicit a specific rationale for the report characteristics that participants expressed preferences, leaving a gap for writing the user story rationales. In these cases, we created the rationale based on our interpretation of the general goals and motivations of participants. We plan to conduct follow-up interviews to check our stories and to continue to iteratively improve the requirements for tailored feedback reports. We anticipate that healthcare organizations may apply a similarly iterative approach to refine and adapt user stories.

Conclusions

We have explored the application of a user-centered design methods with user stories to develop tailored displays for clinical performance feedback. We found that these methods enabled the representation of complex requirements across healthcare professional roles. We anticipate that healthcare organizations could use this method to improve the design of visual displays in clinical quality dashboards and reports. We plan to develop these methods to incorporate participatory design approaches and metadata generation to support automated tailoring of clinical performance feedback.

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